

WHAT IS CLAIMED IS:

1. A pressed-contact type semiconductor device comprising:

a first conductivity type of semiconductor substrate;

5 a first diffusion layer formed by diffusing a second conductivity type of impurities on a first side of the semiconductor substrate;

a fourth diffusion layer formed by diffusing a first conductivity type of impurities on the first side of the semiconductor substrate so as to be shallower than the first diffusion layer;

10 a gate electrode provided on the first side of the semiconductor substrate so as to be in contact with the first diffusion layer;

15 a first electrode provided on the first side of the semiconductor substrate so as to be in contact with the fourth diffusion layer;

a second diffusion layer formed by diffusing the second conductivity type impurities on a second side of the semiconductor substrate; and

20 a second electrode provided on the second side of the semiconductor substrate so as to be in contact with the second diffusion layer;

wherein a depth D1 of the first diffusion layer and a depth D2 of the second diffusion layer have a relation of

25

D1 > D2.

2. A pressed-contact type semiconductor device comprising:

a first conductivity type of semiconductor substrate;

5 a first diffusion layer formed by diffusing a second conductivity type of impurities on a first side of the semiconductor substrate;

a fourth diffusion layer formed by diffusing a first conductivity type of impurities on the first side of the semiconductor substrate so as to be shallower than the
10 first diffusion layer;

a gate electrode provided on the first side of the semiconductor substrate so as to be in contact with the first diffusion layer;

15 a first electrode provided on the first side of the semiconductor substrate so as to be in contact with the fourth diffusion layer;

a second diffusion layer locally formed by diffusing the second conductivity type of impurities on a second side of the semiconductor substrate so as to be exposed on a
20 lateral side of the substrate;

a third diffusion layer locally formed by diffusing the second conductivity type of impurities on the second side of the semiconductor substrate so as not to be exposed
25 on the lateral side of the substrate; and

a second electrode provided on the second side of the semiconductor substrate so as to be in contact with the third diffusion layer;

wherein a depth D2 of the second diffusion layer and a depth D3 of the third diffusion layer have a relation of $D2 > D3$.

3. A pressed-contact type semiconductor device comprising:

a first conductivity type of semiconductor substrate;

10 a first diffusion layer formed by diffusing a second conductivity type of impurities on a first side of the semiconductor substrate;

15 a fourth diffusion layer formed by diffusing a first conductivity type of impurities on the first side of the semiconductor substrate so as to be shallower than the first diffusion layer;

a gate electrode provided on the first side of the semiconductor substrate so as to be in contact with the first diffusion layer;

20 a first electrode provided on the first side of the semiconductor substrate so as to be in contact with the fourth diffusion layer;

25 a second diffusion layer locally formed by diffusing the second conductivity type of impurities on a second side of the semiconductor substrate so as to be exposed on a

lateral side of the substrate;

a third diffusion layer locally formed by diffusing the second conductivity type of impurities on the second side of the semiconductor substrate so as not to be exposed on the lateral side of the substrate; and

a second electrode provided on the second side of the semiconductor substrate so as to be in contact with the third diffusion layer;

wherein a depth D1 of the first diffusion layer, a depth D2 of the second diffusion layer and a depth D3 of the third diffusion layer have a relation of $D1 > D2 > D3$.

4. The pressed-contact type semiconductor device according to claim 2, wherein a carrier concentration of the second diffusion layer and a carrier concentration of the third diffusion layer are different from each other.

5. The pressed-contact type semiconductor device according to claim 3, wherein a carrier concentration of the second diffusion layer and a carrier concentration of the third diffusion layer are different from each other.

6. A pressed-contact type semiconductor device comprising:

a first conductivity type of semiconductor substrate;

a first diffusion layer formed by diffusing a second conductivity type of impurities on a first side of the semiconductor substrate;

a fourth diffusion layer formed by diffusing a first conductivity type of impurities on the first side of the semiconductor substrate so as to be shallower than the first diffusion layer;

5 a gate electrode provided on the first side of the semiconductor substrate so as to be in contact with the first diffusion layer;

10 a first electrode provided on the first side of the semiconductor substrate so as to be in contact with the fourth diffusion layer;

a second diffusion layer locally formed by diffusing the second conductivity type of impurities on a second side of the semiconductor substrate so as to be exposed on a lateral side of the substrate;

15 a third diffusion layer locally formed by diffusing the second conductivity type of impurities on the second side of the semiconductor substrate so as not to be exposed on the lateral side of the substrate; and

20 a second electrode provided on the second side of the semiconductor substrate so as to be in contact with the third diffusion layer;

25 wherein a plurality of lifetime control regions each having a lifetime shorter than that of the semiconductor substrate are formed inside the semiconductor substrate so as to be substantially parallel to the substrate surface,

and a first lifetime control region which is most close to the second and third diffusion layers has a lifetime shorter than that of a second lifetime control region which is secondly close to the second and third diffusion layers.

5 7. The pressed-contact type semiconductor device according to claim 6, wherein the first lifetime control region which is most close to the second and third diffusion layers has the shortest lifetime among the lifetime control regions.

10 8. The pressed-contact type semiconductor device according to claim 7, wherein three lifetime control regions each having a lifetime shorter than the semiconductor substrate are formed inside the semiconductor substrate, and a lifetime τ_1 of the first lifetime control
15 region which is most close to the second and third diffusion layers, a lifetime τ_2 of the second lifetime control region which is secondly close to those layers and a lifetime τ_3 of the third lifetime control region which is thirdly close to those layers have a relation of $\tau_1 < \tau_2 <$
20 τ_3 .

9. A pressed-contact type semiconductor device comprising:

 a first conductivity type of semiconductor substrate;
 a first diffusion layer formed by diffusing a second
25 conductivity type of impurities on a first side of the

semiconductor substrate;

5 a fourth diffusion layer formed by diffusing a first conductivity type of impurities on the first side of the semiconductor substrate so as to be shallower than the first diffusion layer;

a gate electrode provided on the first side of the semiconductor substrate so as to be in contact with the first diffusion layer;

10 a first electrode provided on the first side of the semiconductor substrate so as to be in contact with the fourth diffusion layer;

15 a second diffusion layer locally formed by diffusing the second conductivity type of impurities on a second side of the semiconductor substrate so as to be exposed on a lateral side of the substrate;

a third diffusion layer locally formed by diffusing the second conductivity type of impurities on the second side of the semiconductor substrate so as not to be exposed on the lateral side of the substrate; and

20 a second electrode provided on the second side of the semiconductor substrate so as to be in contact with the third diffusion layer;

25 wherein a lifetime control region having a lifetime shorter than that of the semiconductor substrate is formed at a periphery along the lateral side of the substrate, and

an internal interface of the lifetime control region is provided inward from a portion where the internal interface of the second diffusion layer and the internal interface of the third diffusion layer intersect with each other.

5 10. The pressed-contact type semiconductor device according to claim 9, wherein a bevel surface is formed along the lateral side of the semiconductor substrate, and the portion where the internal interface of the second diffusion layer and the internal interface of the third
10 diffusion layer intersect with each other is provided inward from the most inner diameter of the bevel surface.

11. The pressed-contact type semiconductor device according to claim 9, wherein the portion where the internal interface of the second diffusion layer and the
15 internal interface of the third diffusion layer intersect with each other is disposed outward from the most outer diameter of the second electrode.

12. The pressed-contact type semiconductor device according to claim 10, wherein the portion where the
20 internal interface of the second diffusion layer and the internal interface of the third diffusion layer intersect with each other is disposed outward from the most outer diameter of the second electrode.

13. The pressed-contact type semiconductor device
25 according to claim 9, wherein a bevel surface is formed

along the lateral side of the substrate, and a most inner diameter F_b of the bevel surface, a diameter E_b of the portion where the internal interface of the second diffusion layer and the internal interface of the third diffusion layer intersect with each other, a most outer diameter E_a of the second electrode and a most inner diameter F_a of the internal interface of the lifetime control region have a relation of $F_b > E_b > E_a > F_a$.

14. The pressed-contact type semiconductor device according to claim 9, wherein the diameter E_b of the portion where the internal interface of the second diffusion layer and the internal interface of the third diffusion layer intersect with each other, the most outer diameter E_a of the second electrode and the depth D_2 of the second diffusion layer have a relation of $E_b - E_a > 2 \times D_2$.

15. The pressed-contact type semiconductor device according to claim 9, wherein the diameter E_b of a portion where the internal interface of the second diffusion layer and the internal interface of the third diffusion layer intersect with each other, a most outer diameter E_c of the fourth diffusion layer and a distance D_5 between the internal interface of the first diffusion layer and the internal interface of the third diffusion layer have a relation of $E_c < E_b - D_5$.